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The ability to develop successful new products is critical for many organizations. Business experts note that the contribution which new products will make to sales growth is expected to increase by one-third during the 1980s. During this time, the portion of total company profits generated by new products is expected to increase by 50 percent (Booz, Allen & Hamilton, 1982). This need for new product development is particularly important in high technology industries, where the introduction of new products and technologies may be necessary for organizational survival. For companies in highly competitive industries, the issue is not solely the introduction of new products, but also how to quicken the product development process (David, 1984).

The growing importance of the development of new products can pose difficult challenges for management. As many have noted (c.f. Drucker, 1985) current employment policies and management practices may not be adequate to ensure that the organization has the appropriate human resources and management skills necessary to guarantee that new product ideas can be most quickly developed. A variety of concerns have been raised about the effectiveness of organizational structure (Kanter, 1983), human resource policies (Fombrun, et. al., 1984), and management techniques (Frohman, 1978) in enhancing product development.

Recently, a number of strategies have been proposed to identify and enhance factors contributing to innovation and product development in organizations (Burgelman & Sayles, 1986; Drucker, 1985). Since many authors have described how the product development process can be influenced by organizational variables (e.g. Baldridge & Burnham, 1976; Cohen & Mowery, 1984; Damanpour & Evan, 1984), it is not our intent to

review or summarize these findings. Rather, it is our intent to describe a set of management issues facing the specific groups responsible for product development within an organization.

Within many industries, the primary mechanism for product development is the new product team. Although known by a variety of names, this is the group of individuals who must cooperate to develop, design, test market, and prepare the new product for production. These new product teams differ from many other organizational groups in that they are cross functional, face a variety of tasks, and change in composition across time. Successful new product teams must be able to effectively obtain information and resources from others, both inside and outside the organization, process the information and resources internally, and use those inputs to create and gain acceptance of a viable product (Burgelman, 1983). Understanding the operation and management of such groups can be of more than practical usefulness. The complex interactions within such groups and between the product team and other groups within the organization can provide a powerful test of generalizability of traditional research on group processes.

The basic premise of this paper is that group processes, particularly those dealing with boundary management, can influence the success of new product teams. Following a discussion of the methods we used to collect data, we will first describe the task the new product team must complete. Second, we will discuss previous research on boundary spanning, relate this research to the new product team's task, and propose some relationships between boundary management and team performance.

Methods

The findings of this paper were derived both from a review of literature and from over 135 hours of interviews with new product team managers and members at seven corporations in the computer and integrated circuit industries. Four team leaders were interviewed within six weeks of completion or their projects for between three to ten hours. Using a semi-structured interview, we asked these managers how their new product teams were set up, how the teams evolved over time (e.g. key events, crises, tasks), how the teams coordinated their efforts with other groups, and how key decisions were made. Once these descriptive data were compiled, we asked them what they saw as important factors for success of a new product team. In addition, a number of other interviews were conducted. Another team leader was interviewed every four to six weeks over a 20 month period to provide some sense of the potential issues facing a product team as it develops. In addition, four managers of multiple teams, 16 new product team leaders and six members of teams were interviewed during various phases of product development to get a further description and evaluation of team activities. The interviews were tape recorded and transcribed; the transcriptions were then evaluated by multiple raters to identify transitions in the product development process and boundary behaviors.

This sample is not meant to be representative or large enough to test specific hypotheses. Rather, our goal is to ensure that we can adequately represent the task and processes of the new product team. This will allow us to augment the current literature on group process with observations from the field. Hence, the approach we used could loosely be described as a comparative case analysis. This research

strategy was chosen because we believe that the research on group process in organizations is at an early stage of development. Given the lack of formal research on interdependent groups within organizations, we believe that exploration and description, classification of phenomena, and attempting to identify observable patterns of activities must all proceed the proposition and testing of specific hypotheses (Gladstein & Quinn, 1985).

The New Product Team's Task

Recently, Goodman (1986) has presented a strong argument for the necessity of understanding the task of a group as an integral part any model of group performance or group process. Without a clear understanding of a group's task, incorrect generalizations about group behavior are likely (Herold, 1979). Therefore, before discussing the group processes within new product teams, it is important to begin with an understanding of what the teams must do.

A new product team is a set of individuals who are responsible for the development and introduction of products outside the existing product line (Flesher, Flesher & Skelly, 1984). In general, these individuals are interdependent, see themselves as a group, and are viewed by others in the organization as a group (Alderfer, 1976), even though group membership may change and increase over time. A number of new product groups may be created and aborted early in the development process. Those groups that survive have potential access to large organizational resources and may shape the future of the organization (Kidder, 1981).

The key to the success of these groups is to meet the separate task demands at each phase of the product development process. This

requires that the group be able to effectively obtain information and resources from external sources, process the information and resources internally, and use those inputs to create and gain acceptance of a viable product (Burgelman, 1983). Research on new product management has identified six phases of new product development and new product introduction assuming that a new product strategy is in place (Booz, Allen & Hamilton, 1982). These six phases include:

1) Idea generation. This phase is the initial step in new product development. It involves the recognition of a technical opportunity to fill a perceived need in the marketplace (Holt, 1975).

2) Screening and evaluation. The second phase of product development involves the selection of those ideas that deserve further in-depth study. A major intent of this stage is to eliminate ideas not fitting the organization's market or technical strengths (Booz, Allen & Hamilton, 1982).

3) Business analysis. This phase involves determining how the product under consideration fits into the portfolio of other new products (McIntyre & Statman, 1982) and whether it is economically feasible.

4) Development. The development phase centers on the modification of the product idea into a technically feasible prototype. This is the phase in which the group does the bulk of the work designing and building the initial product models.

5) Testing. Testing insures that the new product is capable of meeting both technical and market goals or standards (Von Hipple, 1977). This phase requires monitoring customer complaints and test data (Adler, 1966).

6) Commercialization. The final phase involves the development of the production and marketing capabilities necessary to introduce the product on a large scale, including the development of mechanisms for continuing follow-up and monitoring (Booz, Allen & Hamilton, 1982).

Each phase describes a sequence of events that a product must move through in order to be introduced effectively. One implication of this process is that the activities and focus of a new product team may change over the course of product development.

Although this set of phases suggests a linear sequence of activity, in reality the process is not so straightforward (Frohman, 1978). Like some strategic decisions, new product development often proceeds incrementally (Quinn, 1982). Our interviews suggested that often the original product idea is very general and only slowly becomes more specific. As information is collected and fed into the ongoing decision making process, a greater level of specificity is achieved. As product development continues, the group actually may cycle back through earlier phases or ahead to future phases. For example, during the screening and evaluation stage, there is often a rough prototype available to help in deciding whether to choose that product. In addition, in order to develop an accurate business plan, commercialization costs need to be estimated. Those actually responsible for commercialization need to be notified early enough in the process so that manufacturing facilities are available. If the group waits until the testing phase is finished to do this, the product may well be late to market. It has been shown that there is a need to integrate technical and economic considerations early, or large sums of money can be wasted on a product that is technically feasible but not

commercially viable (Mansfield & Wagner, 1972). The process may cycle through several times, going through several hierarchical levels and numerous functional groups (Burgelman, 1983).

Product development appears to be a messy, undirected process, and indeed, it is less straightforward than the sequential phase model suggests. However, two events serve to define or divide the process and to direct the new product team's activities. We refer to these events as transition points, in that they shape and change the task demands placed on the group. Our data suggest that these transition points divide the group's process into three general segments. Of importance in understanding the group's process, our interviews indicated that each of these segments placed different internal and external demands upon the team.

The first of these transition points generally seems to occur just prior to the major portion of the development phase and it involves the shift from a "possible" project to a "definite" project. During this shift the team moves from a recognition of potential feasibility to commitment to one new product idea. This entails movement from low cost effort with minimal organizational response to major capital investment and commitment from top management (Pessimier, 1977). By this time, the group should have a fairly clear specification of the product. If this is not the case, the group cannot be clear about what it is giving in return for organizational support, which can lead to over- or under-expectations for the product. In addition, the group cannot structure itself internally, because specific goals and schedules will not be in place.

The second transition usually occurs somewhere during the testing phase. The technological problems have been assessed, a prototype exists and has been tested. The team may very will have spent the last several months working under intense pressure trying to finish at the agreed upon date. The transition consists of moving from team ownership of the product to more general organizational ownership. At this time other organizational groups are preparing for large-scale production and distribution of the product. This corresponds to what Quinn and Mueller (1972) would call a technology transfer point, where the emphasis moves from developing the technology to passing information, enthusiasm and authority to use that technology to other groups in the organization. The transition will not be met if the group is either unwilling to relinquish the product or unwilling to continue to work on the product when it has passed into the hands of others. As one of the managers in our sample described it, "...then we had this big fight. Manufacturing wanted to build it now and make repairs later, but engineering wanted to hold it. People were very upset. Manufacturing yanked its people off the team." Later, however, "Now we're helping to train the manufacturing people. The group isn't meeting much though, and people don't seem to know what to do now that the intensity is over."

These two transition points seemed to divide the new product development process into three segments (See Figure 1). These segments could loosely be labeled creation, development and transfer. In order to understand the development of group processes within the new product team, it is necessary to understand the changing task demands over the course of product development. As the demands placed upon the product

team change across the segments of the product development process, we predict that the management of boundary processes and commitment to the product within the team must change.

Boundary Management in New Product Teams

Research on boundary management to date has focused primarily on the organizational and individual levels of analysis. Research at the organizational level has addressed processes by which the organization adapts to its environment by selecting, transmitting, and interpreting information originating in the environment (e.g. Aldrich & Herker, 1977; Child, 1972). Individual level research has concentrated on the characteristics of boundary spanners (e.g. Caldwell & O'Reilly, 1982) and the role conflict these individuals experience (Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964; Keller & Holland, 1975; Organ & Greene, 1974).

Fewer studies of boundary management have been done at the group level. This is surprising, because groups, like organizations, are open systems that need to manage their relationships with the external environment. However, much of the research on groups has been done in the laboratory or with T-groups that work in isolation. For "real" groups, the external environment consists of the organization in which they exist. Groups must interact with interdependent others in order to obtain resources, to coordinate work, make decisions, and exchange inputs and outputs. For some groups, this boundary spanning process consists of carrying out transactions across the organization-environment boundary, as well (Thompson, 1967).

One set of boundary spanning studies that has focused on the group level examines the pattern of work-related information flow in R & D

laboratories (e.g., Allen, 1984; Katz, 1982; Tushman, 1977, 1979). In general, these studies have found a relationship between the input of information by boundary spanners and performance in the group. For example, high-performing R & D project groups showed far greater communication with organizational colleagues outside the group than low-performing teams (Allen, 1984). In addition, communication followed a two-step process, with communication "stars" first getting the information from outside and then translating the information and transmitting it to the group (Tushman, 1979). Although most of the group-level research on boundary spanning has been limited to studying how members bring information into the group, exchange theory would suggest that when a team is part of a system organized by an interconnecting web of relationships, a broader conceptualization of boundary spanning is needed (Bagozzi, 1975).

Boundary Management Decisions

Our interviews suggested that, within new product teams, a number of decisions made by team leaders or others in positions of authority could influence the nature of the interactions the team developed with other groups. Thus, the boundary of the group could be treated as a design variable whereby the decisions made could determine, in part, the nature of the relations the new product team had with other groups within or outside the organization. These decisions fell into: 1) The definition of the boundary; 2) The permeability of the boundary; and 3) The nature of the transactions across the group's boundaries. The literature on groups has also addressed these boundary properties.

Boundary Definition. An important tool for defining the nature of the interactions of the team with other groups involves the decision of

who is included in the team. Including representatives from all groups, with whom the team must deal, on the team is likely to lead to different boundary processes than if relevant groups are not represented. Similarly, the decision of who is on the team will serve to define the resources which the team possesses and those which must be acquired externally. The variability of the team also has implications for the nature of the group's internal interactions (O'Reilly & Caldwell, 1986) and its effectiveness in innovating (O'Reilly & Flatt, 1986).

Boundary Permeability. A second design tool is the extent to which the boundary is open or closed. Groups with open boundaries are potentially less cohesive and more difficult to control than those groups with more rigid boundaries (Alderfer, 1976). The extent to which the boundary is open or closed also can influence the way the group views its environment and defines the problems with which it must deal (Gladstein, 1986).

Boundary Transactions. Choices are also made about the way a team makes transactions across its boundaries. Exchanges can be categorized by what is exchanged between social units as well as the patterns of exchange. Hence, boundary activity can be categorized by whether goods and services, affect and liking, information and ideas, and/or influence and power flow into or out of the group, and by whether group members or outsiders initiate the exchange (Brinberg & Wood, 1983; Tichy & Fombrun, 1979). This broader categorization describes the set of activities needed to engage in social and economic exchanges necessary to accomplish interdependent tasks in environments in which resources are somewhat limited or dispersed throughout the

organization. In addition, this categorization takes into account not only the boundary activities that the group needs to initiate but also the reactive role that group members must play in response to external demands or requests.

While group composition is often defined by the organization, at least in the short ren, and hence initially fixed, boundary permeability and the nature of the boundary transactions can be influenced by the behaviors of the group members. Our interviews indicate that particular roles are often taken on by group members to carry out transactions and change boundary permeability.

Boundary Roles in New Product Teams

As we previously noted, exchange theory would suggest that transactions across a boundary could be described by whether the flow was in to or out of the target group and by whether the transaction was initiated within the group or from outside. The data from our interviews supported this conceptualization and suggest four separate boundary spanning roles. One role, which we term the Scout role, describes those activities whereby group members seek out information or resources from other groups and attempt to bring them back into the group. This is the traditional conception of boundary spanning in organizations. The second role, which we label the Ambassador role, describes the activities taken by group members to transmit information or outputs from the group to outsiders. Thus, the scout and ambassador carry on critical boundary transactions. The two remaining roles represent group members responses to requests from outsiders. The third role represents things done by the group members in response to inputs from outsiders. We describe this as the Sentry role. The final

set of activities represent the group members processing of requests for information or outputs from outsiders and is termed the Guard role. The sentry and guard rules help to define the permeability of the group boundary. Figure 2 illustrates these roles.

This conceptualization of boundary activities is somewhat similar to those discussed for organizational boundary spanners by Adams (1980). He mentions five classes of activities: transacting the acquisition of organizational inputs and the disposal of outputs, filtering inputs and outputs, searching for and collecting information, representing the organization and buffering it from external threat and pressure. At the group level, these activities are likely to be more fluid than described by Adams. In a group, as opposed to an organizational boundary unit (e.g., admissions offices, etc.), there is likely to be a more diverse set of external environments with which to interact, a more general task and fewer formal procedures governing the criteria that determine when to accept or reject inputs and outputs. Also, the group must manage interactions within the organization. These factors suggest that boundary spanning in groups is less bureaucratized than in organizations and that the group must set rules as it goes along or give the boundary spanner more leeway in making decisions.

Given the nature of the new product team's task and the dependence of such groups on others within the organization, boundary activities should be important elements of the team's process. Not surprisingly, this was supported by our interviews. All of our interviewees discussed the importance of managing relationships with other groups as critical to the product development process. Further, the boundary

activities the interviewees described fit well with the theoretical distinctions described above. In the sections which follow, we will draw from the interviews to more fully illustrate the roles.

Scout. We described activities involving bringing information or resources needed by the group in across the boundary as the Scout role. Examples of the kind of information the scout might collect include task-relevant information necessary for problem solution, political data about who supports or opposes the group's activities, and the extent of demand for the group's outputs. As well as collecting information, the scout procures other resources, such as equipment and training necessary for group functioning. When these resources are not given easily it is the scout who must gather intelligence so that the team can negotiate to procure them. Examples of the scout role can be seen in the following remarks made by interviewees:

> "I came back to the group once per week for a staff meeting...I got the news and went back to my team with 'letters from home'."
>
> "I would go around to the other groups to see what was going on. There was a great deal of coordination to take care of and this way I could make sure that components were ordered well enough in advance so that we could get the product out on time."
>
> "We have a kind of detector. She's very sensitive and works with the people interfaces not the technical part. She spends time with all the groups in manufacturing to detect problems so they can be dealt with quickly."

Ambassador. The ambassador role involves representing the groups to outsiders and carrying information, resources, or other outputs that the group chooses to transmit to others. Much of the purpose of this representation is to shape the beliefs and behaviors of others, outside the group (Adams, 1976, 1980). The ambassador develops and maintains

channels of communication in order to explain the group's activities to powerful outsiders and to persuade these outsiders that the group's activities are valuable and should be supported. These functions may involve getting others to commit themselves to, or share the goals of, the group (Kanter, 1983; Kotter, 1982). The following quotations illustrate the ambassador role:

> "After a few weeks we had a design review with all of R & D. We just wanted to make sure that we weren't going off in crazy directions."
>
> "Then we started having meetings with all those people outside the group. There were representatives from purchasing, manufacturing, production planning, the diagnostics group, marketing, everyone. This was an opportunity to give information and hear about new business. Everyone was informed about progress and changes. The minutes were typed on line so that the team and those who weren't at the meeting knew what was going on. The top management group also got copies."
>
> "I go down to where the project first hits and tell 'em what's coming down. I say that four things are coming, and this is the most critical. You can't always say rush, rush, rush. I stop in even when there's nothing urgent, to develop a relationship with those people. I send them minutes of our meetings and when the project gets closer I send them memos explaining what's required and asking what they need from us."
>
> "I'm like a cheerleader, trying to get those guys excited about our products. But I tickle our group too; I'm not going to carry over some half-baked ideas. They'd get tired of that real quickly."

Sentry. The sentry polices the boundary by controlling the information and resources that external agents want to send into the group. Acting as a filter, the sentry decides who can give input, how much of that input will be admitted, and when the flow of input must stop. The sentry protects the group by allowing it to work with minimal distraction. Often external entities try to communicate their priorities, interests, and demands. When this input is desired, the

job of the sentry is to allow entry. When this information and other inputs are not desired, the job of the sentry is to buffer the group (e.g., Thompson, 1967). The sentry absorbs external pressures, such as political tensions, on behalf of the group. An extreme form of buffering is to actually separate the group physically from the rest of the organization. This buffering or sentry function is important in providing the group with the optimal amount of information necessary for effective decision making. For example, some evidence indicates that when action needs to be taken increased levels of information do not improve decision making (c.f., Gladstein & Quinn, 1985; O'Reilly, 1983) and that the costs of information can outweigh its benefits. Examples of the sentry role are expressed as follows:

> "We needed to get input from engineering at the beginning. We didn't want to come up with some kind of Dr. Seuss machine that had to be redesigned later so we let the engineering people in."
>
> "Near the end I talked to the top management group a lot. I tried to protect the group from that kind of pressure though. It's like Tom West said, we won't pass on the garbage and the politics.'"

Guard. External entities may be curious about group activities or attempt to obtain resources or information from the group. The guard role involves monitoring the information and resources that others request from the group and determining what the group will release in response to those demands. The guard role is reactive and requires judgment to determine if it is in the group's best interest to let information out of the group. One external agent may request some equipment and be denied, while another's request is granted because that group has provided something more valuable to the group in return. Examples of the guard role can be seen in the following:

"So we set up living quarters and moved the team away. That kind of intensity needed to be isolated. People kept coming over and saying, How's it going? What are you up to now?' This was at best distracting, at worst like being in a pressure cooker."

"Near the end people started panicking. The top guys would come down and want to know if we were making progress. I told them they had to stop, that they were having a distracting and deleterious effect on the group.'"

Both conceptually and, as our interviews support, in practice, these boundary roles are inter-related. For example, the scout and sentry roles both deal with information that comes into the group. As such, both roles influence group member perceptions of the outside world, because they are likely to filter, consolidate, and interpret external inputs thereby distorting them in some way. They are also prone to the "mum" effect (Zander, 1977) and other selective biases in the processing of information (c.f., O'Reilly, 1983). Similarly, the ambassador and guard roles influence how external entities perceive the group. These roles define what is said and the manner in which it is said to those outside the group. Collectively, the activities these four roles represent serve to define both how the group perceives the external environment and how other actors perceive the group itself.

The roles described here complement those that have been identified elsewhere as important to the innovation process in organizations. Roberts and Fusfeld (1983) argue that gatekeeping, idea generating, championing, project leading and coaching are necessary for successful innovation. The scout role in our model goes beyond gatekeeping by procuring resources and bringing in political as well as technical information. The category scheme we have described adds detail to the championing and project leading roles by specifying those boundary activities that will aid in recognition of a new product idea

(championing) and integrating and coordinating the diverse tasks needed to develop the product (project leading). The product champion must be a skilled ambassador while the project leader must integrate and often simultaneously play the role of scout, ambassador, sentry and guard. Finally, our role set stress the team's proactive role in getting and maintaining the support of the coach.

In describing boundary management in their new product teams, our interviewees indicated that the various boundary roles can be taken on by one individual or by many different people. As well, a sequence of boundary activities may contain elements of more than one role. For example, the group leader may assume all boundary activities or a specific person assigned to interact with separate groups. Roles may be combined, so that when one is in the position of ambassador, scouting is also carried out. Similarly, one individual may play a role or it may be broadly dispersed, when for example, the leader may ask each group member to play the role of guard to keep certain information secret.

Boundary Management-Performance Relationships in New Product Teams

The success of a new product team can be defined by a product that is delivered on time, on budget, at specification, and that is produced and is a market success (Mansfield & Wagner, 1972). We predict that effective boundary management, overseeing and controlling the amount and type of boundary spanning activity, is one of the factors contributing to a new product teams success. More specifically, we suggest that the criticality of boundary spanning roles varies across

the segments of the new product development process. Basically we propse that the scout and ambassador roles are more critical than other boundary roles in the creation segment of the product development process because the task requires many boundary tansactions. During the development segment, we would argue that the sentry and guard roles are more criticla than the others due to a need to reduce the boundary permeability. The diffusion segment should require proportionally more ambassador activity due to an increased need for cross boundary transactions.

In the first segment of the product development process, we would predict that the scout and ambassador roles are more critical than other boundary roles. Our interviewees suggested that it is during the creation segment of the product development process that effective groups (or individuals who will later form the group) must collect large amounts of market, technical, and political information (Kanter, 1983; Maquis, 1969; Tushman, 1977). In order to develop ideas, screen them, and evaluate their economic feasibility, information from the external environment, top management, and other functional areas is necessary. In addition to technical and market based activities, an understanding of the corporate tradition and management thinking may be needed to know whether the product might be included in the corporate strategy (Burgelman, 1983). Collecting this information represents the role of the scout. During this segment of the product development process, gaining top management support and the cooperation of other interdependent groups may also be crucial. Burgelman, in his study of internal corporate venturing describes this as "...necessary to demonstrate that what conventional corporate wisdom had classified as

impossible was, in fact, possible" (1983, p. 232). This may require informally obtaining resources to demonstrate product feasibility or creating early market interest in the product even before top management is committed to the product's development.

When the primary task of a group is to gather information, resources or expertise outside the group, we hypothesize that effective groups will increase those activities related to scouting. Depending upon what resources the group requires, increased scouting activities may be directed toward a variety of outside groups (Pfeffer, 1985). When cooperation from others is needed for future acceptance of the group's outputs, we predict that in effective groups, the scout will start early in the group's existence to identify areas of support and opposition to the team's efforts.

At this stage, those activities making up the ambassador role are predicted to be high in effective groups as well. The ambassador uses the information from the scout, working to maintain the support from those who have given it and trying to obtain it from key individuals who oppose the groups's plans but whose support is needed. Cooperation and support are built early, and those who agree to cooperate are kept informed of group progress. Once these groups have a stake in the group's output, they need to be updated on progress. Thus, when outside support and cooperation are necessary but not present, we predict that high performing teams will increase the amount of selling that the ambassador performs. This is particularly important at the beginning of the group's existence. Once support is obtained, high-performing teams will continue to need a fair amount of ambassador activity, but its form may change.

The literature on group behavior would suggest that it is important that this role develop early in the team's existence and data from our interviews support this contention. Friedlander and Scott (1981) found that work group activities were give more legitimization and were more likely to be implemented when there was a back and forth flow of ideas with top management. In addition, once a work or information channel is established, over time it tends to be used for other unrelated purposes (March & Simon, 1958) so that outsiders who are given information early in the team's development may reciprocate with assistance for the team. Our interviewees suggested that effective ambassadors worked to build informal channels with other groups. Descriptions of the processes they undertook in doing this were not unlike those requirements for voluntary coordination identified by Whetten (1983).

In the second segment of the product development process, we hypothesize that the sentry and guard roles are more critical than other boundary roles. It is during the development segment, when partial isolation of the team is most important, that the team must specify the new product design well enough to set goals and schedules for the team. In order for this to be done, inputs from external agents regarding their priorities and suggestions for the product design need to be halted (unless market or competitive information radically changes). This is the sentry function. We would predict that the more effective teams will be the ones that are able to get the inputs they need and then to consolidate this information and move on to development. Groups which are not able to effectively manage this taking in of information and then using it may lose valuable time or

suffer reduced effectiveness. Groups that continue to incorporate outside inputs may continually change work goals and schedules so that group progress and motivation may suffer. As one new product team manager put it, "They just couldn't decide which chip they were going to use. It was debated and changed and debated until the cost and delivery got out of control. We had to scrap the whole thing and most of that team left the company."

The sentry must protect the group from this sort of input overload by making the group boundary less permeable. The team needs to spend its time on technical development; it is at this point that the group must transform the inputs into a finished product. Innovation and speed can be gained by having the sentry serve as a buffer against external interference and imposed organizational norms (Friedlander, 1984; Galbraith, 1982; Rogers, 1982).

The guard also buffers the team. While the group is in the development phase external agents will want to know what the group is doing, how much progress has been made, or when the product will be finished. Our interviewees suggested that if the team is to work effectively, it cannot be interrupted constantly. Therefore, we propose that the more important the team's product, and the more interruptions and requests for information and resources, the more the guard role is necessary. In addition, teams will often be in competition for resources and will want product information in order to compete more successfully. We hypothesize that high performing teams will manage their profile and limit their exposure to others via the guard role.

It is important to note that although we propose that the sentry and guard roles are most important in the second segment of new product development, the ambassador and scout roles still are necessary. The sentry and guard provide the protection needed to meet the second crisis. It is possible that the product will not be pushed ahead to commercialization unless the team is left alone to complete development. Technical expertise, information about competing groups and top management support, and resources in the form of equipment and personnel may also be needed to meet the demands at this second crisis point. The scout takes on these activities, while the ambassador's activities continue in order to garner support and maintain others' commitments to the product idea. Nonetheless, we would postulate that the latter two roles are required less during this second segment of activity.

In the final segment of the product development process, we hypothesize that the ambassador role is more critical than other boundary roles. It is during the transfer that effective teams must convey technical data as well as a sense of ownership to the groups that will manufacture and market the new product. The ambassador role is critical in this endeavor. The breadth of the transition is such that it may be necessary for most group members to assume some ambassador activities. The transfer of ownership of the new product may be difficult for the team. The nature of the second segment of the development process may have caused the team to have developed a very impermeable boundary. Although the isolation this boundary creates may be important in innovation, its existence and the cohesiveness that has

developed may become detrimental at this stage. We propose that the potential of this occurring makes the ambassador role critical.

Overall, we hypothesize that the criticality of the boundary roles change depending upon the particular tasks required at each phase of the product development process. General support for this hypothesis comes from a study of engineering research institutes. Ryssina and Koroleva (1984) studied the relationship between roles and team performance. Although examining slightly different roles, their findings support role differentiation and active management of boundary activity. In their study, these two factors were associated with closer scientific contacts, better cooperation and increased effectiveness. The research indicated that the generator of ideas and gatekeeper (like scout) were of primary importance in early phases, then the teams focused inward with the burden of activity falling on the leader and research technique specialist. Finally, the leader, specialist and interface manager become most important.

Implications for Team Management and Future Research

An improved understanding of complex groups such as new product teams may have implications for improving the management of teams and more importantly, increasing and improving research on groups.

We have identified four roles which encompass these boundary activities. The scout, ambassador, sentry, and guard accomplish the myriad transactions with the external environment. Roles will not always be taken on automatically. If support for the propositions in this paper is forthcoming, we would suggest that the team leader must assign these roles to group members and evaluate them on their performance in these roles. Role performance is also influenced by the

organizational context. The team leader must work to make organizational reward and control mechanisms encourage and reward effective role behavior.

The propositions presented here have implications for research as well as management. First and foremost the paper advocates studying teams within their organizational context in order to examine boundary as well as internal processes. Also inherent in the propositions is recognition that groups should be monitored over time and their interactions monitored both across levels in the hierarchy and across functional lines. This broad perspective is needed to understand more of the group behaviors that may be necessary to meet the task demands of complex interdependent tasks like new product development.

Much of the current literature on group functioning suggests that team leaders spend their time fostering good internal group processes such as effective decision making and problem solving, supportiveness and trust, (e.g., Argyris, 1966; Dyer, 1977; Zander, 1977). While these processes are clearly important in team management, this paper outlines other areas of group process. New product team leaders, and the leaders of all groups that are interdependent with external entities, must successfully manage a complex set of boundary activities as well if the group is to meet its goals.

Much of the current group literature uses cross sectional data. Those researchers who have taken a developmental approach have focused on the resolution of two major issues: authority and intimacy (How will leadership emerge and how close will we become?) (c.f. Hare, 1973). Development has been modeled as a sequetnial process shuch as:

develops as group members confron issues of authority; 3) members agree on norms and rules; and 4) work leads to completion of the task (Heinen & Jacobsen, 1976). This view of development concentrates on the internal interpersonal changes in behavior seen in groups over time. Our findings support the developmental approach but indicate a need to focus on the evolution of boundary asa well as internal processes. This research also raises the question of whether changes in group process follow shifts in task demands rather than an universal stage sequence. Future research will have to address this issue.

Beyond the identification of boundary roles related to the product development process, the data from our interviews lead us to speculate about an additional implication for research, that is, what are the effects of a group's internal processes on the nature of its boundary relations.

The Interaction of Internal and External Group Processes

An area worth some speculation is how the internal processes of the group influence the permeability of the boundary and boundary transactions (c.f. Gladstein, 1984). Our interviews suggested that at least two internal processes influenced boundary activities. These processes were the development and management of members' commitments to the team and product and the management of the stream of decisions involved in developing the new product.

Managing Commitment. Our interviews suggested that managing the creation, maintenance and control of the teams members' commitment to the project is important in shaping both the relations of the new product team with other groups and the overall success of the product development process. The new product development process has many

unforeseen demands and pressures and as one manager we interviewed stated, "there isn't one project that hasn't gone through a stage where the members thought they had failed -- where they thought it couldn't be done." Despite this, examples abound of teams expending tremendous effort in the face of apparent failure (c.f. Kidder, 1981). Many of our interviewees recounted stories of marathon work days, willingly forgone vacations, and intense effort toward the development of the new product. It may be, that becoming "fanatically committed" (Quinn, 1979) to the new product is often necessary for team success in the face of perceived failure.

Commitment may be paradoxical however. Although intense commitment may be very motivating for team members, it may also have negative effects. Recent research (c.f. Staw, 1982) has described how individuals become bound by their previous actions in such a way that they become committed to an unsuccessful strategy. This process of escalating commitment has been termed "entrapment" (Rubin & Brockner, 1975) or having "too much invested to quit" (Teger, 1980). Such entrapping commitment may prevent the team from abandoning poor strategies or lead the team to ignore new information. Similarly, commitment lead individuals to distort or manipulate information (Caldwell & O'Reilly, 1984). All of these negative outcomes may serve to limit the new product team's ability to exchange information with those other groups upon which it may be dependent.

Thus, commitment may have implications for boundary behaviors. For example, a "fanatically" committed group may develop a less permeable boundary by exhibiting higher levels of sentry and guard activities than necessary. Similarly, the commitment may distort the

boundary transactions such that the group concentrates on exporting its views without importing new information. This then is the paradox of commitment. While "fanatical" commitment may be necessary to complete a project, the existance of such commitment may make it difficult for the group to work with others or to ultimately give over the "ownership" of the project to others.

Increasing amounts of research have identified how the processes by which individuals undertake an action may lead to commitment (c.f. O'Reilly & Caldwell, 1981; Salancik, 1977) and how such commitment may be maintained in organizations (c.f. Pfeffer, 1981). One area for future research is the management of commitment at the group level of analysis, including its implications for internal and boundary processes.

Managing the Decision Making Process. A second internal process that is likely to influence the product team's interactions with outside groups is the nature of the decision making within the team. As others have noted (c.f. Janis, 1982), the internal process of the group and the decisions it makes can influence external group processes. Our interviewees suggested that the way decisions were made by the product team had the potential to influence the way the group managed its boundary.

In order to understand how decision making can influence boundary management in new product teams, it is useful to begin with an understanding of "why" decisions are made. Brunsson (1982) compares two models of decision making; decision rationality and action rationality. Decision rationality corresponds to most normative models of decision making whereby the goal of decision making is to make the

"best" decision. Processes such as collecting all available information, specifying complete sets of alternatives, and ranking alternatives in terms of expected values are called for. Making "good" decisions requires avoiding such irrational processes as group think (Janis, 1982) or rigid responses to threat (Staw, Sandelands & Dutton, 1981).

Action rationality differs from decision rationality in that the aim may not be to arrive at the "best" decision in some abstract sense, but to involve people in the decision making process so as to gain their input in molding the decision and build their commitment to it. The issue is less one of group effectiveness (whether what is being done should be done) and more one of how the decision can best be carried out (Pfeffer & Salancik, 1978). Since action rationality has the building of commitment as a primary criterion for success, this implies that few alternatives will be analyzed, a narrow range of potential consequences should be used to choose among the alternatives, and implementation issues should be dominant throughout the entire process (Brunsson, 1982; Gladstein & Quinn, 1984). In contrast to decision rationality, action rationality suggests that the consideration of all the pros and cons of multiple alternatives is normally avoided because it could evoke dysfunctional uncertainty.

Our interviews suggest that a team operating under decision rationality exhibits a more permeable boundary that one operatin under action rationality. Those teams using a decision rationality approach displayed an openness for new information. Team members seemed ready to move outside the boundary to generate new alternatives and obtain information on their pros and cons. Teams operating under action

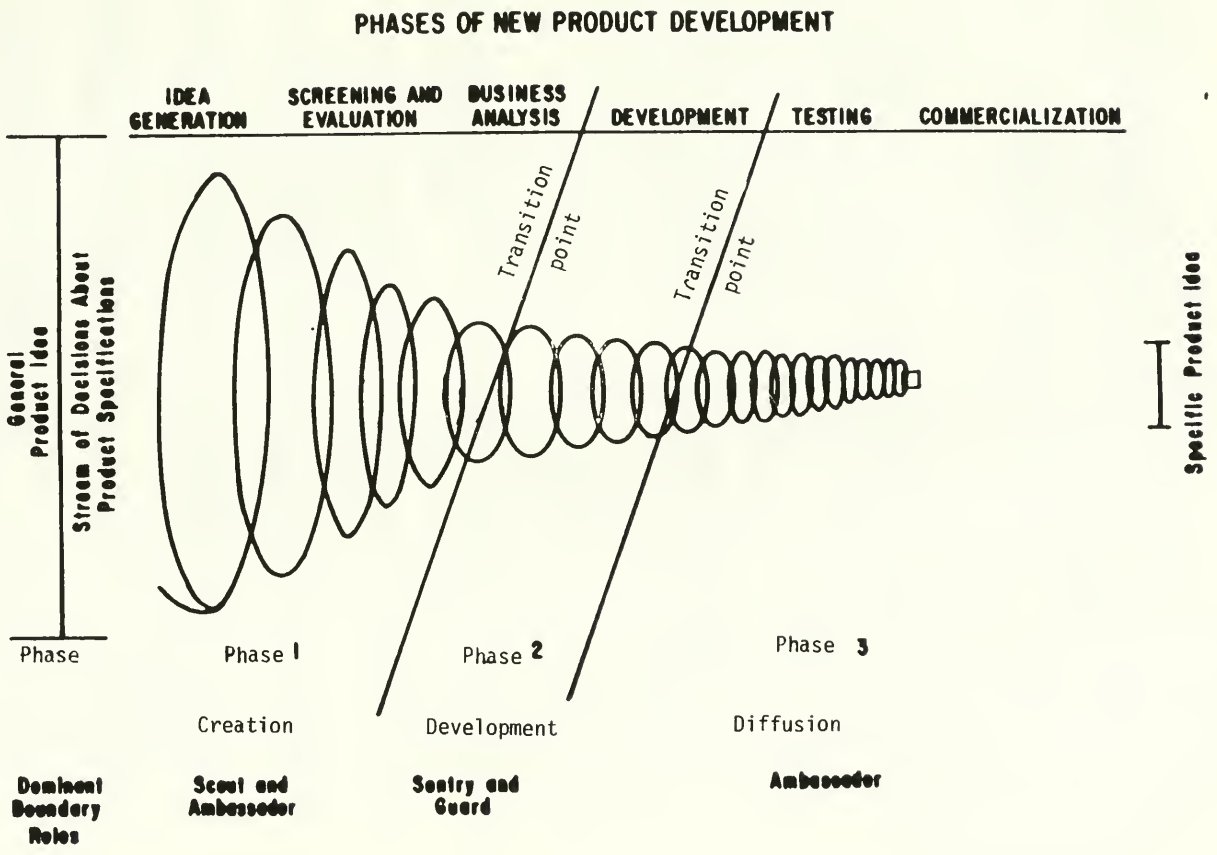
rationality often wanted to accelerate the decsion making process and seemed less inclined to seek new inforamtion which might impede the decsion making process.

Summary

These conclusions have implications in two general areas. First, they suggest that part of the success in effectively developing new products is a function of the extent to which the product development team is able to manage its relationships with other groups.

Second, internal processes may have an impact on boundary activities and this relationship needs to be examined in future research. Whereas group research has typically looked at task and maintenence activities, our work suggest a third area of group functioning: boundary management.

FIGURE 1


PHASES OF NEW PRODUCT DEVELOPMENT
IDEA GENERATION
SCREENING AND EVALUATION
BUSINESS ANALYSIS
DEVELOPMENT
TESTING
COMMERCIALIZATION
Transition point
Transition point
General Product Idea
Stream of Decisions About Product Specifications
Specific Product Idea
Phase
Phase 1
Phase 2
Phase 3
Creation
Development
Diffusion
Dominant Boundary Roles
Scout and Ambassador
Sentry and Guard
Ambassador

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